

NONPROVISIONAL PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

OLIFF & BERRIDGE, PLC

Attorney Docket No.: 103253

P.O. Box 19928

Alexandria, Virginia 22320

Date: April 15, 1999

Telephone: (703) 836-6400

Facsimile: (703) 836-2787

BOX PATENT APPLICATION

NONPROVISIONAL APPLICATION TRANSMITTAL  
RULE §1.53(b)

Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 C.F.R. §1.53(b) is the nonprovisional patent application

For (Title): ELECTRONIC STILL CAMERA AND INFORMATION RECORDING APPARATUS

By (Inventors): Michihiro TAMUNE

- ☒ Formal drawings (Figs. 1-9; 10 sheets) are attached.  
☒ A Declaration and Power of Attorney is filed herewith.  
☒ An assignment of the invention to Nikon Corporation is filed herewith.  
☐ An Information Disclosure Statement is filed herewith.  
☐ A statement to establish small entity status under 37 C.F.R. §§1.9 and 1.27 is filed herewith.  
☐ A Preliminary Amendment is filed herewith.  
☐ Please amend the specification by inserting before the first line the sentence --This nonprovisional application claims the benefit of U.S. Provisional Application No. \_\_\_\_\_, filed \_\_\_\_\_.--  
☒ Priority of foreign application No. 10-106548 filed April 16, 1998 in Japan is claimed (35 U.S.C. §119).  
☒ A certified copy of the above corresponding foreign application is filed herewith.  
☒ The filing fee is calculated below:

CLAIMS IN THE APPLICATION AFTER ENTRY OF  
ANY PRELIMINARY AMENDMENT NOTED ABOVE

FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	18 - 20	= 0
INDEP CLAIMS	4 - 3	= 1
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIMS PRESENTED		

\* If the difference is less than zero, enter "0".

**SMALL ENTITY**

RATE	FEE
	\$ 380
x 9 =	\$
x 39 =	\$
+130 =	\$
TOTAL	\$

**OTHER THAN A  
SMALL ENTITY**

RATE	FEE
	\$ 760
x 18	\$
x 78	\$ 78
+260	\$
TOTAL	\$ 838

- ☒ Check No. 67659 in the amount of \$838.00 to cover the filing fee is attached. Except as otherwise noted herein, the Commissioner is hereby authorized to charge any other fees that may be required to complete this filing, or to credit any overpayment, to Deposit Account No. 15-0461. Two duplicate copies of this sheet are attached.
- ☐ This application is entitled to small entity status. DO NOT charge large entity fees to our Deposit Account.

Respectfully submitted,

*Thomas J. Pardini*

James A. Oliff  
Registration No. 27,075

Thomas J. Pardini  
Registration No. 30,411

### **Inventor Information**

Inventor One Given Name:: Michihiro  
Family Name:: TAMUNE  
Name Suffix::  
City of Residence:: Yokohama-shi  
State or Prov. of Residence:: Kanagawa  
Country of Residence:: JAPAN  
Inventor Two Given Name::  
Family Name::  
Name Suffix::  
City of Residence::  
State or Prov. of Residence::  
Country of Residence::  
Inventor Three Given Name::  
Family Name::  
Name Suffix::  
City of Residence::  
State or Prov. of Residence::  
Country of Residence::  
Inventor Four Given Name::  
Family Name::  
Name Suffix::  
City of Residence::  
State or Prov. of Residence::  
Country of Residence::  
Inventor Five Given Name ::  
Family Name::  
Name Suffix::  
City of Residence::  
State or Prov. of Residence::  
Country of Residence::

### **Correspondence Information**

Name Line One:: Oliff & Berridge PLC  
Address Line One:: P.O. Box 19928  
City:: Alexandria  
State or Province:: VA  
Postal or Zip Code:: 22320  
Telephone:: (703) 836-6400  
Fax:: (703) 836-2787  
Electronic Mail:: ob@oliff.com

### **Application Information**

Title Line One:: ELECTRONIC STILL CAMERA AND  
Title Line Two:: INFORMATION RECORDING APPARATUS  
Title Line Three::  
Title Line Four :

Total Drawing Sheets:: 10  
Docket Number:: 103253

### **Continuity Information**

>This application is a::  
Application One::  
Filing Date::  
Patent Number::  
which is a::  
>>Application Two::  
Filing Date::  
Patent Number::

### **Prior Foreign Applications**

Foreign Application One:: 10-106548  
Filing Date:: April 16, 1998  
Country:: Japan  
Priority Claimed:: yes  
Foreign Application Two::  
Filing Date::  
Country::  
Priority Claimed::  
Foreign Application Three::  
Filing Date::  
Country::  
Priority Claimed::

Patent Application

# ELECTRONIC STILL CAMERA AND INFORMATION RECORDING APPARATUS

## INCORPORATION BY REFERENCE

The disclosure of the following priority application is  
5 herein incorporated by reference:  
Japanese Patent Application No. 10-106548, filed April 16, 1998

## BACKGROUND OF THE INVENTION

### 1. FIELD OF THE INVENTION

10 The present invention relates to an electronic still  
camera and an information recording apparatus that record a  
subject as electronic image data.

### 2. DESCRIPTION OF THE RELATED ART

There are single lens reflex type electronic still cameras  
15 in the prior art. A single lens reflex type electronic still  
camera is provided with a viewfinder device to which a subject  
image passing through a taking lens is guided by a quick return  
mirror, an image capturing device such as a CCD that is  
provided at a stage to the rear of the quick return mirror to  
20 capture the subject image and output image data, an image  
processing circuit that performs image processing such as white  
balance adjustment and  $\gamma$  control on the image data output by  
the image capturing device, a compression circuit that  
compresses data having undergone image processing by adopting a  
25 method such as JPEG to store them in a storage medium such as a

flash memory and a monitor that displays data that has undergone the image processing. In the image processing circuit, based upon the image data output by the image capturing device, parameters including the R gain and the B gain for white balance adjustment or the gradation curve for  $\gamma$  control using a preset algorithm are calculated.

In such a single lens reflex type electronic still camera, the number of pixels at the image capturing device has been steadily increasing over the years to exceed a million or even two million pixels, resulting in a tendency for a longer period of time required for image processing. In particular, when calculating the gradation curve for  $\gamma$  control to achieve high quality image processing, a significant length of time is required for the analysis of a photographic scene. In addition, a large-scale, complex image processing circuit is required. Moreover, the length of time required for calculating the R gain and the B gain for white balance adjustment also increases when the number of pixels at the image capturing device becomes large. It is to be noted that these problems may likewise occur in various other types of electronic still cameras having an image capturing device with the number of pixels exceeding 1 ~ 2 million.

## SUMMARY OF THE INVENTION

An object of the present invention is to provide an electronic still camera and an information recording apparatus that are capable of reducing the length of time required for image processing which is implemented by analyzing the photographic scene.

In order to achieve the object described above, the electronic still camera according to the present invention comprises a photographic image capturing device that outputs image data by capturing a subject image passing through a taking lens, an analytic image capturing device provided at a position adjacent to the position that is conjugate with the photographic image capturing device relative to the taking lens, that receives the subject image and outputs image data for scene analysis, an analyzing circuit that performs scene analysis of the subject image based upon the image data for scene analysis output by the analytic image capturing device and an image processing circuit that performs image processing on the image data output by the photographic image capturing device based upon the results of the scene analysis output by the analyzing circuit.

It is desirable that the number of pixels at the analytic image capturing device be smaller than the number of pixels at the photographic image capturing device.

The analyzing circuit is capable of calculating parameters

such as coefficients and gains to support various types of image processing performed by the image processing circuit.

The analytic image capturing device may be divided into a plurality of areas each having a plurality of pixels which receive light forming the subject image so that the analyzing circuit can calculate the parameters based upon image data for scene analysis output from the plurality of areas.

The analyzing circuit is capable of calculating a gradation ( $\gamma$ ) curve based upon the brightness value indicated by the image data for scene analysis, and the image processing circuit is capable of correcting photographic image data based upon the gradation curve. In this case, too, the analytic image capturing device may be divided into a plurality of areas so that the analyzing circuit can calculate the gradation curve based upon image data for scene analysis output from the plurality of areas.

The image data for scene analysis output by the analytic image capturing device contain RGB signals, the analyzing circuit calculates the gains for white balance adjustment based upon the RGB signals and the image processing circuit corrects the photographic image data based upon the gains for white balance adjustment.

The parameters mentioned above may be calculated at the image processing circuit instead of at the analyzing circuit.

In this case, the image processing circuit calculates

parameters such as coefficients and gains to be used in various types of image processing based upon the image data corresponding to, at least, a specific area among the photographic image data output by the photographic image capturing device, and the analyzing circuit determines the specific area based upon the results of the scene analysis.

The present invention may be adopted in a single lens reflex type electronic still camera. Namely, a single lens reflex type electronic still camera according to the present invention comprises a viewfinder device to which a subject image passing through a taking lens is guided by a quick return mirror, a photographic image capturing device provided at a stage to the rear of the quick return mirror that outputs image data by capturing the subject image, an analytic image capturing device provided at the position adjacent to the position which is conjugate with the photographic image capturing device relative to the taking lens, that receives the subject image guided to the viewfinder device and outputs image data for scene analysis, an arithmetic operation circuit to which the image data for scene analysis output by the analytic image capturing device are input so that it can calculate in advance parameters such as coefficients and gains to be used for image processing and an image processing circuit that performs image processing on the image data output by the photographic image capturing device by using the parameters



calculated at the arithmetic operation circuit.

In the single lens reflex type electronic still camera, too, the parameters mentioned earlier may be calculated at the image processing circuit instead of at the analyzing circuit.

5 Namely, such a single lens reflex type electronic still camera should be provided with an image processing circuit that calculates parameters such as coefficients and gains to be used for various types of image processing based upon image data corresponding to, at least, a specific area among photographic  
10 image data output by the photographic image capturing device and performs image processing on the photographic image data using these parameters and an analyzing circuit that performs scene analysis of the subject image based upon the image data for scene analysis output by the analytic image capturing  
15 device and determines the specific area based upon the results of the analysis.

The information recording apparatus according to the present invention comprises, at least, a first image capturing device and a second image capturing device that output image  
20 data by capturing a subject image passing through a taking lens, an analyzing circuit that performs scene analysis on the subject image by using the image data output by, at least, either the first image capturing device or the second image capturing device, an analyzing circuit that performs scene  
25 analysis of the subject image by using the image data output

by, at least, either the first image capturing device or the second image capturing device and an image processing circuit that performs image processing on the image data output by, at least, either the first image capturing device or the second  
5 image capturing device based upon the results of the scene analysis performed by the analyzing circuit.

It is desirable that the first and second image capturing devices have different numbers of pixels from each other and that image data output by the image capturing device having the smaller number of pixels be input to the analyzing circuit.  
10

The analyzing circuit is capable of calculating parameters such as coefficients and gains for various types of image processing to be performed at the image processing circuit.

It is desirable that the image capturing device to be employed for scene analysis be divided into a plurality of  
15 areas so that the analyzing circuit can perform scene analysis based upon image data for scene analysis output from the plurality of areas. A plurality of pixels are provided in each divisional area.

20 The analyzing circuit is capable of calculating a gradation ( $\gamma$ ) curve based upon the brightness value indicated by the image data for scene analysis, and the image processing circuit is capable of correcting the photographic image data based upon the gradation curve.

25 The image capturing device employed for scene analysis may

be divided into a plurality of areas. Each area has a plurality of pixels receiving the subject image light. The analyzing circuit is capable of calculating the gradation curve based upon image data for scene analysis output from the plurality of areas.

The image data for scene analysis output by the image capturing device employed for scene analysis contain RGB signals, the analyzing circuit calculates the gains for white balance adjustment based upon the RGB signals and the image processing circuit is capable of correcting the photographic image data based upon the gains for white balance adjustment.

Alternatively, the image processing circuit may calculate parameters such as coefficients and gains to be used for various types of image processing based upon image data corresponding to, at least, a specific area among the photographic image data output by the image capturing device employed for photographing and the analyzing circuit may determines the specific area based upon the results of the scene analysis.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the structure of a single lens reflex type electronic still camera in an embodiment of the present invention;

FIG. 2 is a block diagram of one embodiment of the signal

processing system in the single lens reflex type electronic still camera;

FIG. 3 presents an example of the image capturing device for scene analysis;

5 FIG. 4 illustrates the color filter in the image capturing device for scene analysts and also presents an example in which grouping into 16 blocks is implemented;

FIG. 5 is a flowchart illustrating a program that is started up with a half-press switch;

10 FIGS. 6A ~ 6D illustrate gradation curves;

FIG. 7 is a flowchart illustrating a program that is started up with a full-press switch;

FIG. 8 is a flowchart illustrating another program that is started up with the half-press switch; and

15 FIG. 9 shows a person against a red background.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following is an explanation of the embodiments of the present invention given in reference to the drawings. As  
20 illustrated in FIG. 1, the single lens reflex type electronic still camera in this embodiment is provided with a camera main body 70, a viewfinder device 80 that may be attached to and detached from the camera main body 70 and an interchangeable lens 90 provided with an internal taking lens 91 and an  
25 internal aperture 92, that may be attached to and detached from

the main body 70. Subject light travels through the interchangeable lens 90 to enter the camera main body 70, is led to the viewfinder device 80 by a quick return mirror 71 which is at the position indicated by the dotted line before a shutter release operation and an image is formed at a viewfinder mat 81. This subject image is further guided to an ocular lens 83 by a pentaprism 82. In addition, the subject image passes from the pentaprism 82 to a prism 84 and an optical element 85 and is formed on the photosensitive surface of an image capturing device for scene analysis 86. After a shutter release operation, on the other hand, the quick return mirror 71 rotates to the position indicated by the solid line and the subject light travels via an aperture 72 to form an image on an image capturing device for photographing 73. The image capturing device for scene analysis 86 is provided at a position adjacent to the position that is conjugate with the image capturing device for photographing 73 relative to the taking lens 91.

FIG. 2 is a circuit block diagram of the embodiment. When a half-press switch 11 is operated, the analytic image capturing device 86 starts an electrical charge storage or accumulation, and when the accumulation ends, the analytic image capturing device 86 outputs RGB image data for scene analysis to an analyzing circuit 10. The analyzing circuit 10 converts the image data to a digital signal, and performs scene

analysis of a photographic scene based upon the digital image signal. The results of the analysis are transferred to an image data control circuit 21.

If, on the other hand, a full-press switch 12 is operated, the quick return mirror rotates upward, the subject light from the interchangeable lens 90 forms an image on the photosensitive surface of the photographic image capturing device 73 and a signal electrical charge corresponding to the brightness of the subject image is accumulated at the photographic image capturing device 73. The signal electrical charge accumulated at the photographic image capturing device 73 undergoes analog processing such as gain control at an analog signal processing circuit 22, and then it is converted to a digital signal at an A/D conversion circuit 23. The signal that has undergone the digital conversion is then supplied to an image processing circuit 24 where it undergoes image processing such as white balance adjustment, contour compensation and  $\gamma$  control to become formatted, and it travels through a frame memory controller 25 to be temporarily stored at a frame memory 26. The various parameters used in the image processing performed by the image processing circuit 24 are calculated in advance at the scene analyzing circuit 10 and are stored within the memory in the control circuit 21.

The image data stored in the frame memory 26 are processed into image data for display by a display image generating

circuit 27 and are displayed on an external monitor 28 such as an LCD as the photographic results. In addition, the image data stored in the frame memory 26 undergo data compression at a specific ratio through a method such as JPEG at a compression circuit 29 and are recorded in a camera internal memory (storage medium) 30 such as a flash memory.

Next, a detailed explanation is given on the image capturing device for scene analysis 86 and the scene analyzing circuit 10. The image capturing device for scene analysis 86 may be constituted of, for instance, a single two-dimensional CCD having 480 separate pixels provided over 24 columns (across) X 20 rows (down) as illustrated in FIG. 3. On the front surface of the image capturing device 86, an RGB color filter 861 which is divided into a total of 480 blocks over 24 columns (across) X 20 rows (down) in correspondence to the 480 pixels, as illustrated in FIG. 4, is provided. The 480-block RGB filter is grouped into 16 blocks; B11, B12 ... B43 and B44 each having 6 columns (across) X 5 rows (down) filter elements, to be utilized for scene analysis. The image capturing device 86 is divided into 16 areas each having 30 pixels. In this context, scene analysis refers to an analysis related to the information on the brightness of the photographic scene, the RGB signal distribution state and the like.

Next, the procedure through which the gradation curve is determined by analyzing a scene is explained in reference to

FIGS. 5 ~ 7. When the half-press switch 11 is operated, the program illustrated in FIG. 5 is started up, and in step S1, the image capturing device for scene analysis 86 accumulates an electrical charge achieved by the subject light with its image formed on the photosensitive surface of the image capturing device for scene analysis 86 over a specific length of time before sequentially outputting the accumulated RGB image data to the scene analyzing circuit 10. In step S2, the brightness value  $Y_{ij}$  ( $i = 1 \sim 20$ ,  $j = 1 \sim 24$ ) for each of the 480 pixels is calculated, and in step S3, the full average value  $Y_{ave}$  is calculated. In step S4, a block average brightness value  $Y_{ave} 1 \sim Y_{ave} 16$  for the 16 individual blocks  $B11 \sim B44$  are calculated. Then the operation advances to step S5 in which the differences among the block average brightness values  $Y_{ave} 1 \sim Y_{ave} 16$  are calculated and the absolute value  $Y_{abs}$  of the largest brightness difference is calculated. In step S6, the absolute value  $Y_{abs}$  and a preset threshold value  $Y_{max}$  are compared with each other to perform scene analysis. Then, in step S7, a decision is made with respect to which of the four gradation curves prepared in advance as illustrated in FIG. 6A ~ 6D is to be used based upon the results of the scene analysis as explained below.

(1) If the absolute value  $Y_{abs}$  of the largest brightness difference is smaller than the preset threshold value  $Y_{max}$ , the photographic scene is determined to be a halftone preference



type. In the case of the halftone preference type, the S-shaped gradation correction curve illustrated in FIG. 6A is used. This assures a halftone gradation.

(2) When the absolute value  $Y_{abs}$  of the largest brightness difference is equal to or larger than the preset threshold value  $Y_{max}$ , the difference  $Y_{diff}(i)$  between the full pixel average brightness  $Y_{ave}$  and the average brightness  $Y_{ave}(i)$  in each block is calculated as follows.

$$Y_{diff}(i) = Y_{ave} - Y_{ave}(i) \dots (1)$$

Here,  $i$  represents an integer within the range of  $1 \sim 16$ .

A check is performed to ascertain whether or not there are a plurality of contiguous blocks in each of which  $Y_{diff}(i)$  is smaller than a preset threshold value  $Y_{highlight}$  or there are a plurality of contiguous blocks in which  $Y_{diff}(i)$  is larger than a preset threshold value  $Y_{shadow}$ , and based upon the results of the check, the scene is analyzed, as described below. It is to be noted that; threshold value  $Y_{highlight} <$  threshold value  $Y_{shadow}$ .

(2-1) If there are a plurality of contiguous blocks for each of which  $Y_{diff}(i)$  is smaller than the threshold value  $Y_{highlight}$ , the scene is determined to be the highlight preference type. In the case of the highlight preference type, the gradation correction curve illustrated in FIG. 6B is used. This assures gradation from halftone through highlight.

(2-2) If there are a plurality of contiguous blocks in each

of which  $Y_{diff}(i)$  is larger than the threshold value  $Y_{shadow}$ , the scene is determined to be the shadow preference type. In the case of the shadow preference type, the gradation correction curve illustrated in FIG. 6C is used. This assures gradation from shadow through halftone.

(2-3) If there are a plurality of contiguous blocks for each of which  $Y_{diff}(i)$  is smaller than the threshold value  $Y_{highlight}$  and there are a plurality of contiguous blocks for each of which the  $Y_{diff}(i)$  is larger than the threshold value  $Y_{shadow}$ , the scene is determined to be the highlight-shadow preference type. In the case of the highlight-shadow preference type, the gradation correction curve illustrated in FIG. 6D is used. This assures gradation in the shadow area and the highlight area.

Then, in step S8, the pitches or inclinations and the  $\gamma$  values of the individual gradation curves are calculated by using the full brightness average value  $Y_{ave}$ , the block average brightness values  $Y_{ave\ 1} \sim Y_{ave\ 16}$  and  $Y_{diff}(i)$ , and the ultimate gradation curve is determined using these data. In step S9, the gradation curve thus calculated is transferred to the photographic control circuit 21. The control circuit 21 then stores the gradation curve in its memory. The operations in steps S1 ~ S9 described above are repeated until the full-press button is operated in step S10.

When the full-press button 12 is operated, the quick

return mirror swings upward and the program with the  
photographing sequence illustrated in FIG. 7 is started up. In  
step S21, a light reception signal is accumulated at each pixel  
in the image capturing device 73, and when the accumulation is  
5 completed, the accumulated electrical charges at all the pixels  
are sequentially output. In step S22, the image data thus  
output are processed at the analog signal processing circuit  
22, and are then converted to digital image data at the AD  
conversion circuit 23 before they are input to the image  
10 processing circuit 24. Next, the operation proceeds to step  
S23, in which the image data undergo gradation correction by  
using a gradation curve calculated in advance at the scene  
analyzing circuit 10 and stored in memory. It is to be noted  
that the image processing circuit 24 also engages in white  
15 balance adjustment and the like. When the image processing is  
completed, the operation proceeds to step S24, in which the  
image data that have undergone image processing are temporarily  
stored in the frame memory 26. In step S25, the image data are  
compressed at the compression circuit 29 through the JPEG  
20 method, and then, in step S26, the compressed image data are  
stored in the storage medium 30.

As explained above, when the half-press switch 11 is  
operated, the scene analyzing circuit 10 calculates the  
gradation curve which is then transferred to the control  
25 circuit 22 to be stored in its memory in this embodiment. The

calculation for the gradation curve is executed repeatedly while the half-press switch 11 is being operated, and the memory contents are overwritten with the latest data. Then, when the full-press switch 12 is operated and an image is  
5 formed of the subject light at the photographic image capturing device 73, the image capturing device 73 accumulates electrical charges achieved by the subject light over a specific length of time and then outputs them sequentially. Since the image processing circuit 24 performs the gradation correction using  
10 the gradation curves that are stored in memory in advance, it is not necessary to calculate the gradation curve using the photographic image data themselves, whose volume is very large, so that the length of time required for gradation correction processing can be reduced.

15 Next, the procedure that is taken to calculate the R gain and the B gain to be utilized for white balance adjustment based upon the results of the scene analysis is explained in reference to the flowchart in FIG. 8. In step S31, electrical charges achieved by the subject light received at the image  
20 capturing device for scene analysis 86 are accumulated over a specific length of time, and then the RGB image data for scene analysis are sequentially output to the scene analyzing circuit 10. In step S32, matching processing, in which the difference in the color characteristics between the image capturing device  
25 for scene analysis 86 and the image capturing device for

photographing 73 is performed. The matching processing may be achieved through processing in which matrix calculation is performed for a matrix constant of, for instance,  $3 \times L$  ( $L \geq 3$ ) and raw RGB data, for instance.

5 In step S33, using the RGB signals (brightness values) corresponding to all the 480 pixels, an R gain full pixel average value  $R_{gave}$  and a B gain full pixel average value  $B_{gave}$  are calculated. The method for calculating the R gain and the B gain using the individual brightness values indicated by the RGB signals is of the known art, and therefore its explanation is omitted. In step S34, R gain block average values  $R_{gave1} \sim B_{gave16}$  and the B gain block average values  $B_{gave1} \sim B_{gave16}$  for the 16 individual blocks  $B11 \sim B44$  are calculated.

10 Then the operation proceeds to step S35, in which absolute values  $R_{gdif1} \sim R_{gdif16}$  of the gain differences between the R gain full pixel average value  $R_{gave}$  and the R gain block average values  $R_{gave1} \sim R_{gave16}$  and absolute values  $B_{gdif1} \sim B_{gdif16}$  of the gain differences between the B gain full pixel average value  $B_{gave}$  and the B gain block average values  $B_{gave1} \sim B_{gave16}$  are calculated based upon the following equation.

$$R_{gdif}[i] = |R_{gave} - R_{gave}[i]| \dots (2)$$

$$B_{gdif}[i] = |B_{gave} - B_{gave}[i]| \dots (3)$$

Here,  $i$  represents an integer within the range of  $1 \sim 16$ .

15 In step S36, each of the absolute values  $R_{gdif1} \sim R_{gdif16}$  of the gain differences is compared with a threshold value

Rdifmax and each of the absolute values Bgdif1 ~ Bgdif16 of the gain differences is compared with a threshold value Bdifmax. Based upon these comparisons, the R gain and the B gain for white balance are determined as described below.

5 (1) If the absolute values Rgdif1 ~ Rgdif16 of the gain differences are all smaller than the threshold value Rdifmax, the R gain full pixel average value Rgave is selected as the R gain. If the absolute values Bgdif1 ~ Bgdif16 of the gain differences are all smaller than the threshold value Bdifmax,  
10 the B gain full pixel average value Bgave is selected as the B gain.

(2) If any of the absolute values Rgdif1 ~ Rgdif16 of the gain differences is equal to or larger than the threshold value Rdifmax, the blocks having absolute values indicating gain  
15 differences smaller than the threshold value Rdifmax are selected, and the average value calculated based upon the total of the absolute value(s) Rgdif(i) of the gain difference(s) corresponding to one or a plurality of such blocks, is set as the R gain. If any of the absolute values Bgdif1 ~ Bgdif16 of  
20 the gain differences is equal to or larger than the threshold value Bdifmax, the blocks having absolute values indicating gain differences smaller than the threshold value Bdifmax are selected, and the average value calculated based upon the total of the absolute value(s) Bgdif(i) of the gain difference(s)  
25 corresponding to one or a plurality of such blocks, is set as

the B gain.

In step S37, the R gain and the B gain thus calculated are transferred to the photographic control circuit 21. The control circuit 21 then stores the R gain and the B gain in its memory. Subsequently, the operation in steps S31 ~ S37 are repeated until the full-press button is operated in step S38.

When the full-press button 12 is operated, the quick return mirror swings upward and the program with the photographing sequence illustrated in FIG. 7 is started up. In step S21, a light reception signal is accumulated at each pixel in the image capturing device 73, and when the accumulation is completed, the accumulated electrical charges at the pixels are sequentially output. In step S22, the image data thus sent out are processed at the analog signal processing circuit 22 and are then converted to digital image data at the AD conversion circuit 23 before they are input to the image processing circuit 24. Next, the operation proceeds to step S23, in which white balance adjustment is performed for the image data by using the R gain and the B gain calculated in advance at the scene analyzing circuit 10 and stored in memory. It is to be noted that the image processing circuit 24 performs other types of image processing such as  $\gamma$  control using the gradation curves and the contour compensation.

As described above, when the half-press switch 11 is operated, the R gain and the B gain for white balance

adjustment are calculated at the scene analyzing circuit 10,  
which are then transferred to the control circuit 21 to be  
stored in its memory in this embodiment. The calculation of  
the R gain and the B gain is executed repeatedly while the  
5 half-press switch is being operated so that the memory contents  
at the memory are overwritten with the latest data. Then, when  
the full-press switch 12 is operated and the subject light  
forms an image at the photographic image capturing device 73,  
the image capturing device 73 accumulates electrical charges  
10 achieved by the subject light over a specific length of time  
and sequentially outputs them. The image processing circuit 24  
performs white balance adjustment using the R gain and the B  
gain that are stored in memory in advance on the image data.  
Thus, it is not necessary to calculate the R gain and the B  
15 gain for white balance adjustment by using the photographic  
image data themselves, whose volume is very large, so that the  
length of time required for white balance adjustment can be  
reduced. In addition, in a scene with a person against a red  
sign RB as a background as illustrated in FIG. 9, white balance  
20 adjustment can be achieved by excluding the area that is  
predominantly red so that the color of the persons skin and the  
like can be expressed more faithfully.

While the analyzing circuit 10 and the control circuit 21  
are illustrated separately in FIG. 2, the present invention is  
25 configured so that the programs in FIG. 5 and FIG. 7 or the



programs in FIG. 5 and FIG. 8 are executed by a single microprocessor.

It is to be noted that the gradation curve and the R gains and the B gains for white balance adjustment may be calculated at the scene analyzing circuit 10 and transferred to the control circuit 21 for accumulation so that both the high quality image processing using the gradation curve and the white balance adjustment are executed using these parameters.

In addition, in the explanation given above, the gradation curve, and the R gain and the B gain are calculated at the analyzing circuit 10 based upon the image data from the image capturing device for scene analysis 86 to be transferred in advance to the photographic control circuit 21 for accumulation. However, white balance adjustment may be achieved in the following manner, instead. Based upon the results of scene analysis, a block in which the absolute value of the gain difference is smaller than the threshold value is selected and the information related to the position of the block is transferred to the control circuit 21. At the control circuit 21, the photographic image data within the area corresponding to the block positional information among the image data from the photographic image capturing device 73 are taken in from the image processing circuit 24 to calculate the R gain and the B gain for white balance adjustment. In other words, the scene analyzing circuit 10 only calculates the area

corresponding to the image data required for calculating the R gain and B gain. By calculating in advance the image area at the photographic image capturing device 73 to be utilized for the image processing based upon scene analysis results obtained at the image capturing device for scene analysis 86 provided at a position adjacent to the position that is conjugate with the position of the image capturing device for photographing 73 in this manner, the image processing performed based upon the results of the scene analysis can be completed within a shorter period of time compared to the prior art, as in the embodiment described earlier.

In addition, the present invention is ideal for application in various other types of electronic still cameras and information recording apparatuses with a large number of pixels (e.g., one million pixels or more) in addition to single lens reflex type electronic still cameras.

Furthermore, in an electronic still camera or an information recording apparatus provided with at least a pair of image capturing elements each receiving a subject image that has been coloristically separated, a scene analysis may be performed by using the entirety of or a portion of the image data at one of the image capturing elements.

In this case, the scene analysis may be implemented by using the image data corresponding to a specific portion, with the number of pixels at the image capturing elements set equal

to each other. While the explanation is given above on the gradation curve and the gains for white balance adjustment, image processing may be implemented using parameters other than these based upon the results of scene analysis.

What is claimed is;

1. An electronic still camera comprising:

a photographic image capturing device that outputs image  
5 data by capturing a subject image passing through a taking  
lens;

an analytic image capturing device provided at a position  
adjacent to the position that is conjugate with said  
photographic image capturing device relative to the taking  
10 lens, that receives light forming the subject image and outputs  
image data for scene analysis;

an analyzing circuit that performs scene analysis of said  
subject image based upon the image data for scene analysis  
output by said analytic image capturing device; and

15 an image processing circuit that performs image processing  
on the image data output by said photographic image capturing  
device based upon scene analysis results output by said  
analyzing circuit.

20 2. An electronic still camera according to claim 1, wherein:

said analytic image capturing device has a smaller number  
of pixels than said photographic image capturing device.

3. An electronic still camera according to claim 2, wherein:

25 said analyzing circuit calculates parameters such as

coefficients and gains for various types of image processing performed at said image processing circuit.

4. An electronic still camera according to claim 3, wherein:

5       said analytic image capturing device is divided into a plurality of areas each having a plurality of pixels receiving the subject image and said analyzing circuit calculates the parameters based upon image data for scene analysis output from said plurality of areas.

10       5. An electronic still camera according to claim 2, wherein:

      said analyzing circuit calculates a gradation ( $\gamma$ ) curve based upon brightness values in the image data for scene analysis; and

15       said image processing circuit corrects photographic image data based upon the gradation curve.

6. An electronic still camera according to claim 5, wherein:

20       said analytic image capturing device is divided into a plurality of areas each having a plurality of pixels receiving the subject image and said analyzing circuit calculates the gradation curve based upon image data for scene analysis output by a plurality of areas.

25       7. An electronic still camera according to claim 2, wherein:

the image data for scene analysis output by said analytic image capturing device contain RGB signals, said analyzing circuit calculates gains for white balance adjustment based upon the RGB signals and said image processing circuit corrects  
5 the photographic image data based upon gains for white balance adjustment.

8. An electronic still camera according to claim 2, wherein:

10 said image processing circuit calculates parameters such as coefficients and gains to be utilized for various types of image processing based upon image data corresponding to, at least, a specific area among the photographic image data output by said photographic image capturing device; and

15 said analyzing circuit determines the specific area based upon scene analysis results.

9. A single lens reflex type electronic still camera, comprising:

20 a viewfinder device to which a subject image passing through a taking lens is guided by a quick return mirror;

a photographic image capturing device provided at a stage to the rear of the quick return mirror, that captures the subject image and outputs image data;

25 an analytic image capturing device provided at a position adjacent to the position that is conjugate with said

photographic image capturing device relative to the taking lens, that receives light forming the subject image guided to said viewfinder device from the quick return mirror and outputs image data for scene analysis;

5 an arithmetic operation circuit that is supplied with the image data for scene analysis output by said analytic image capturing device, and calculates in advance parameters such as coefficients and gains to be utilized for image processing based upon the image data for scene analysis; and

10 an image processing circuit that performs image processing on the image data output by said photographic image capturing device using the parameters calculated at said arithmetic operation circuit.

15 10. A single lens reflex type electronic still camera, comprising:

a viewfinder device to which a subject image passing through a taking lens is guided by a quick return mirror;

a photographic image capturing device provided at a stage  
20 to the rear of the quick return mirror, that captures the subject image and outputs image data;

an analytic image capturing device provided at a position adjacent to the position that is conjugate with said photographic image capturing device relative to the taking  
25 lens, that receives light forming the subject image guided to

said viewfinder device from the quick return mirror and outputs image data for scene analysis;

an arithmetic operation circuit that is supplied with the image data for scene analysis output by said analytic image capturing device, and calculates in advance parameters such as coefficients and gains to be utilized for image processing based upon the image data for scene analysis; and an image processing circuit that calculates parameters such as coefficients and gains to be utilized for various types of image processing based upon image data corresponding to at least, a specific area among photographic image data output by said photographic image capturing device and performs image processing on the photographic image data using the parameters; and

an analyzing circuit that performs scene analysis on the subject image based upon the image data for scene analysis output by said analytic image capturing device and determines the specific area based upon results of the scene analysis.

11. An information recording apparatus, comprising:

at least a first image capturing device and a second image capturing device that output image data by capturing a subject image passing through a taking lens;

an analyzing circuit that performs scene analysis on the subject image using image data output by, at least, either said



first image capturing device or said second image capturing device; and

an image processing circuit that performs image processing on image data output by, at least, either said first image capturing device or said second image capturing device based upon scene analysis results obtained at said analyzing circuit.

12. An information recording apparatus according to claim 11, wherein:

said first image capturing device and said second image capturing device have different numbers of pixels from each other, and image data output by an image capturing device having a smaller number of pixels are input to said analyzing circuit.

13. An information recording apparatus according to claim 12, wherein:

said analyzing circuit calculates parameters such as coefficients and gains for various types of image processing performed at said image processing circuit.

14. An information recording apparatus according to claim 13, wherein:

said image capturing device utilized for scene analysis is divided into a plurality of areas each having a plurality of

pixels receiving the subject image and said analyzing circuit performs scene analysis based upon image data for scene analysis output from the plurality of areas.

5 15. An information recording apparatus according to claim 12, wherein:

said analyzing circuit calculates a gradation ( $\gamma$ ) curve based upon brightness values in the image data for scene analysis; and

10 said image processing circuit corrects photographic image data based upon the gradation curve.

16. An information recording apparatus according to claim 15, wherein:

15 said image capturing device utilized for scene analysis is divided into a plurality of areas each having a plurality of pixels receiving the subject image and said analyzing circuit calculates the gradation curve based upon image data for scene analysis output from the plurality of areas.

20

17. An information recording apparatus according to claim 12, wherein:

the image data for scene analysis output by said image capturing device for scene analysis contain RGB signals, said  
25 analyzing circuit calculates gains for white balance adjustment

based upon the RGB signals and said image processing circuit corrects photographic image data based upon the gains for white balance adjustment.

5 18. An information recording apparatus according to claim 12, wherein:

10 said image processing circuit calculates parameters such as coefficients and gains to be utilized for various types of image processing based upon image data corresponding to, at least, a specific area among photographic image data output by said image capturing device for photographing; and

said analyzing circuit determines the specific area based upon scene analysis results.

# ABSTRACT OF THE INVENTION

An electronic still camera is provided with a photographic image capturing device that outputs image data by capturing a subject image passing through a taking lens, an analytic image capturing device provided at a position adjacent to the position that is conjugate with the photographic image capturing device relative to the taking lens that receives light forming the subject image and outputs image data for scene analysis, an analyzing circuit that performs scene analysis of the subject image based upon the image data for scene analysis output by the analytic image capturing device and an image processing circuit that performs image processing based upon the results of the scene analysis output by the analyzing circuit. The gradation curve, and the R gain and the B gain for white balance adjustment are determined based upon the results of the scene analysis using the image data for scene analysis output by the image capturing device for scene analysis provided separately from the photographic image capturing device.

FIG. 1

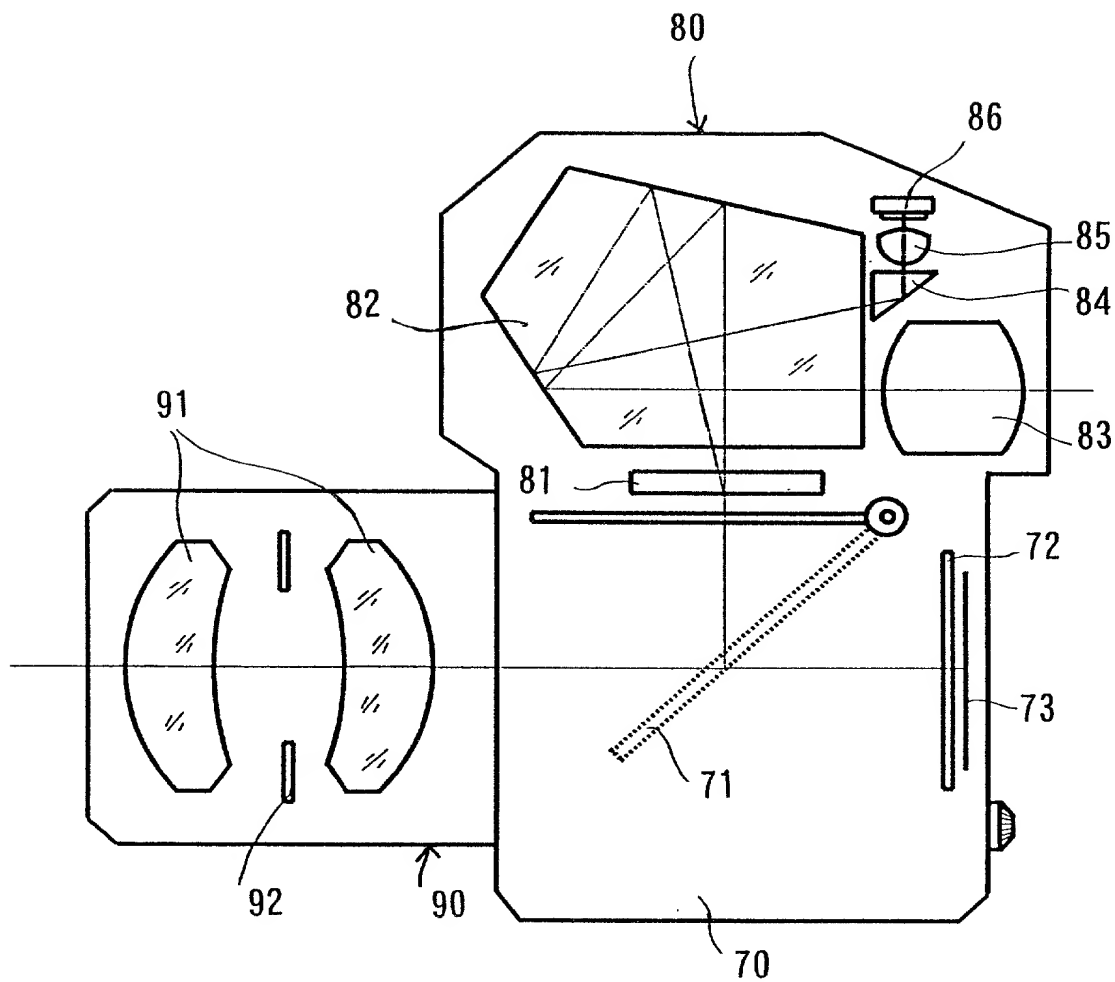
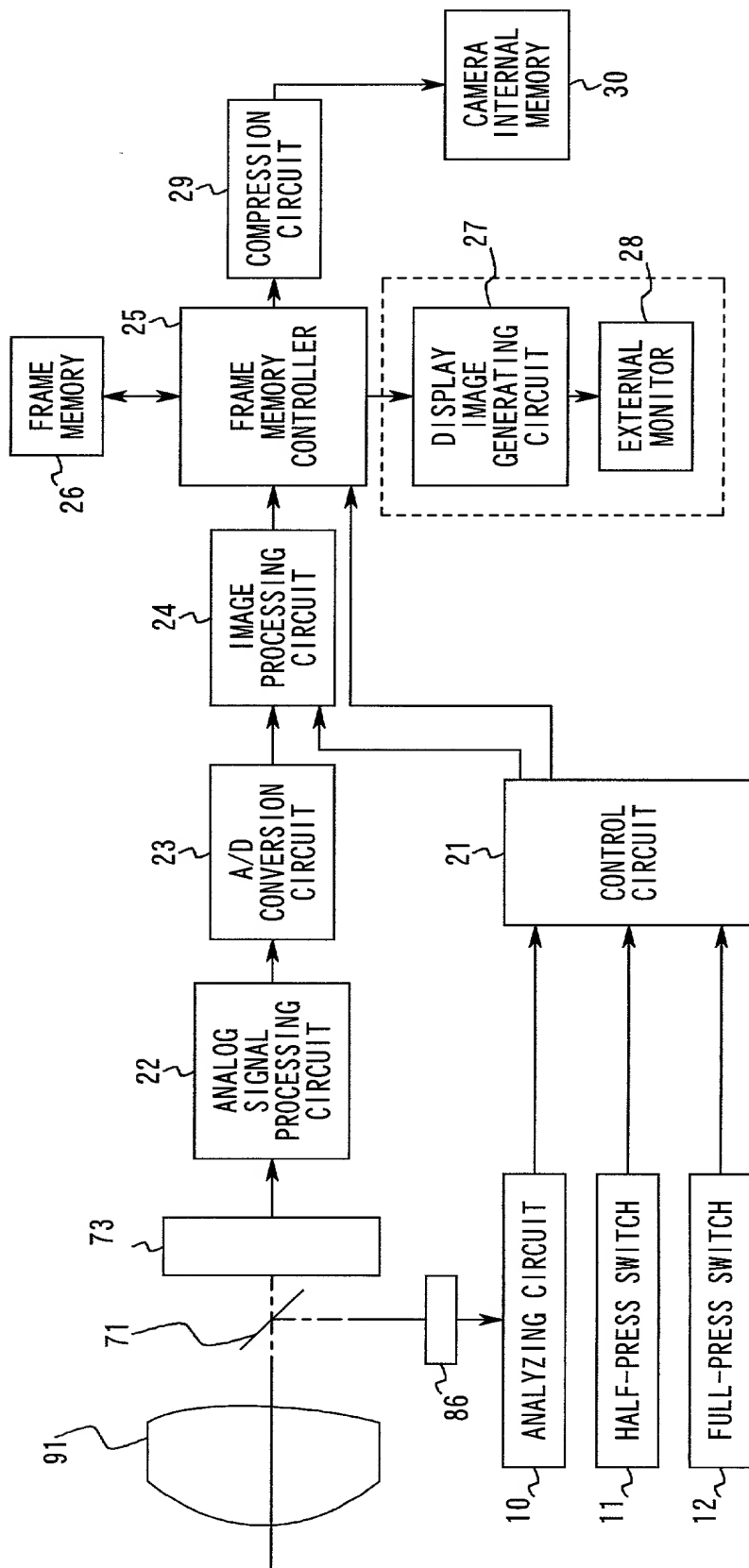


FIG. 2



86

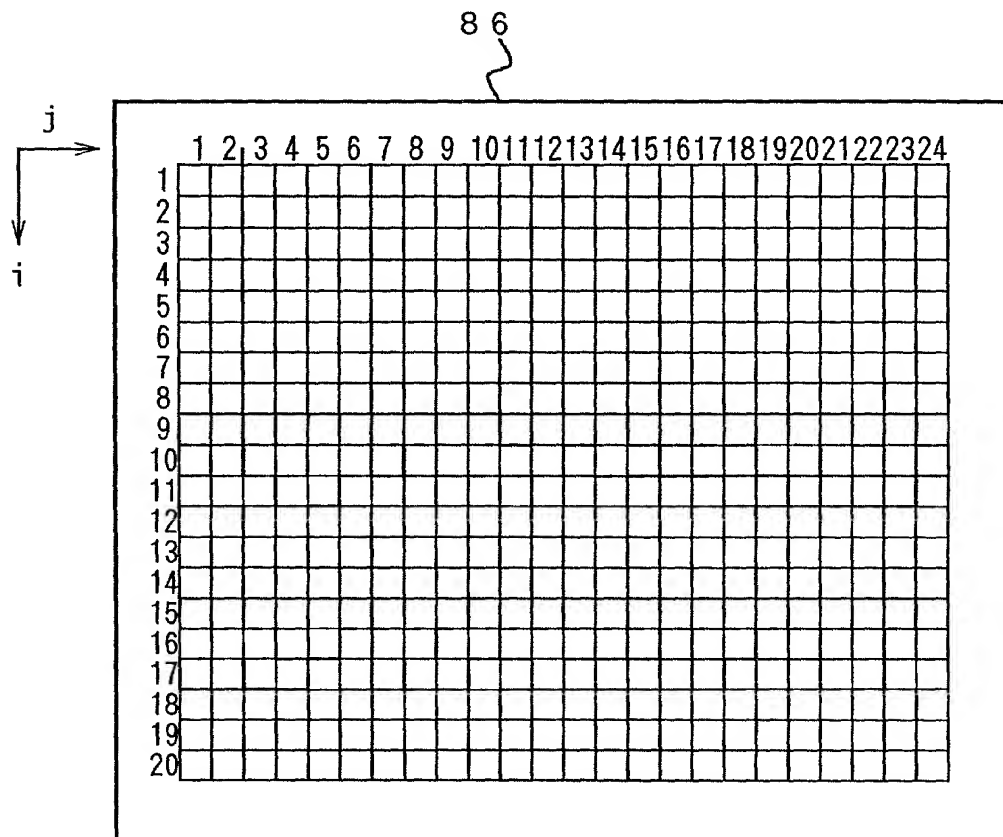


FIG. 4

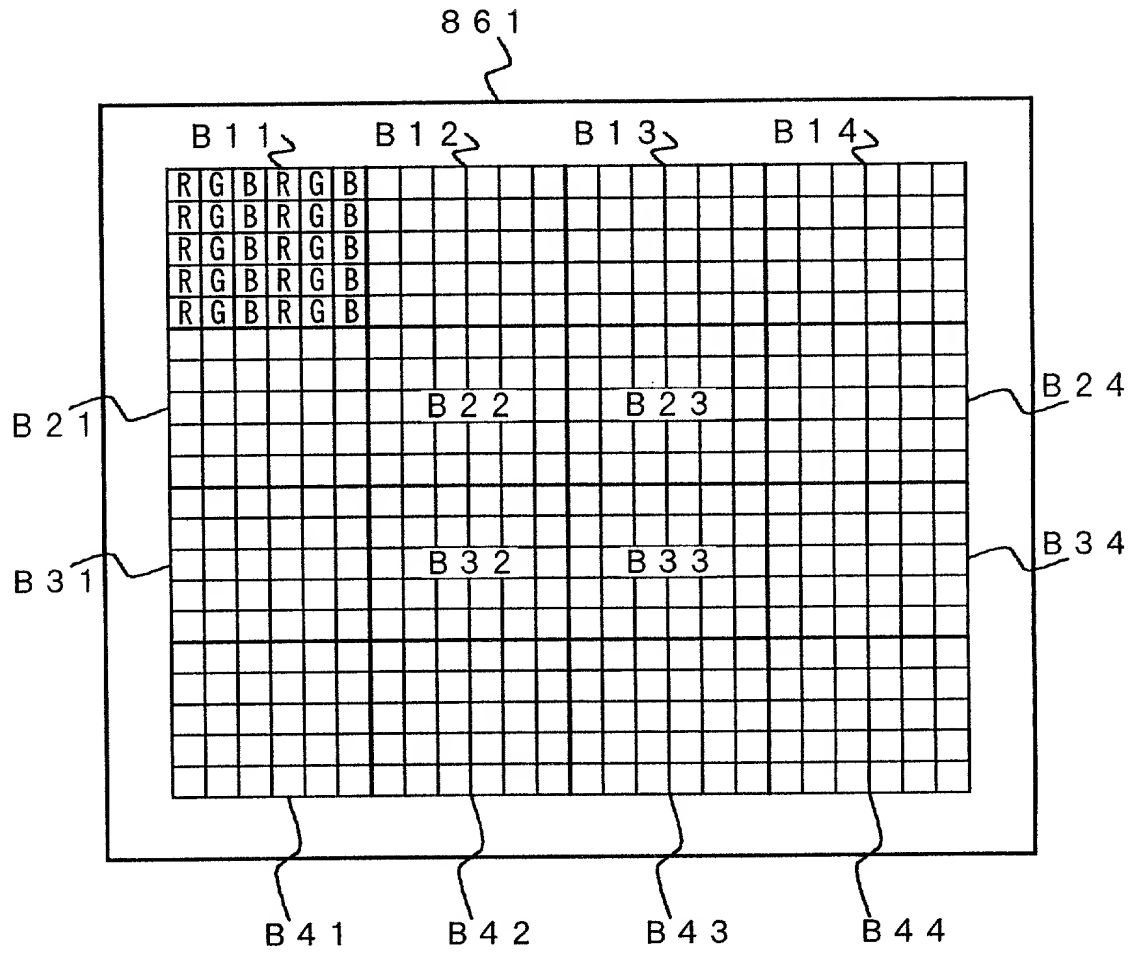




FIG. 5

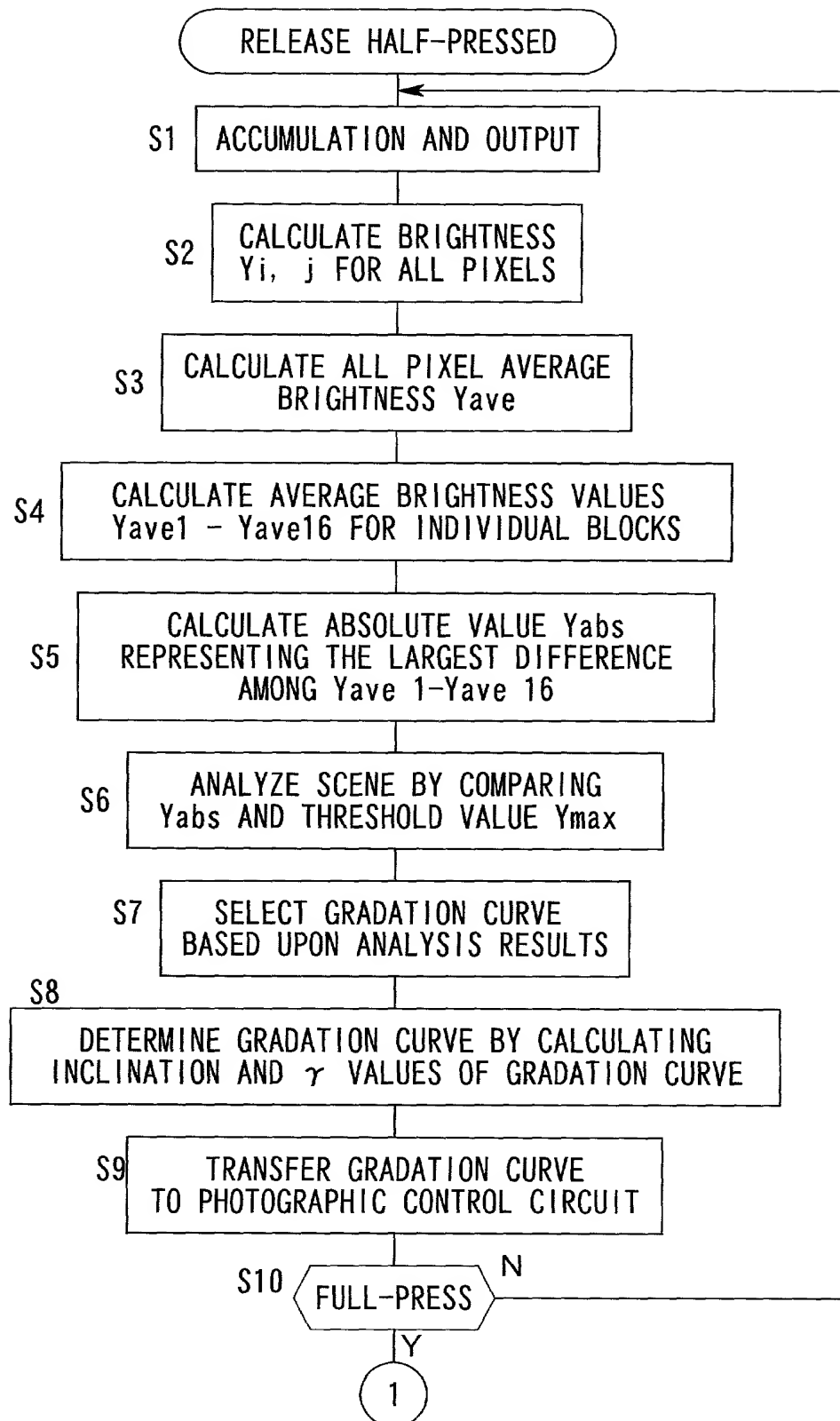


FIG. 6A

HALFTONE PREFERENCE TYPE

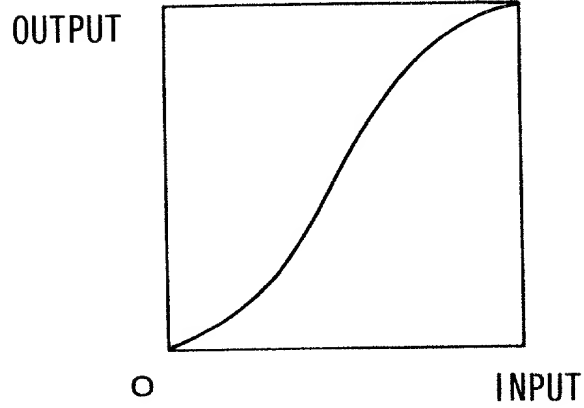


FIG. 6B

HIGHLIGHT PREFERENCE TYPE

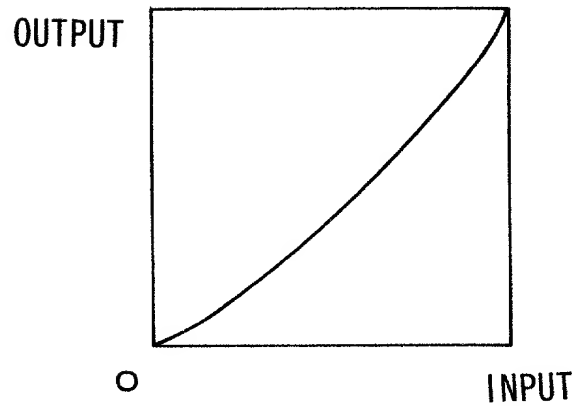


FIG. 6C

SHADOW PREFERENCE TYPE

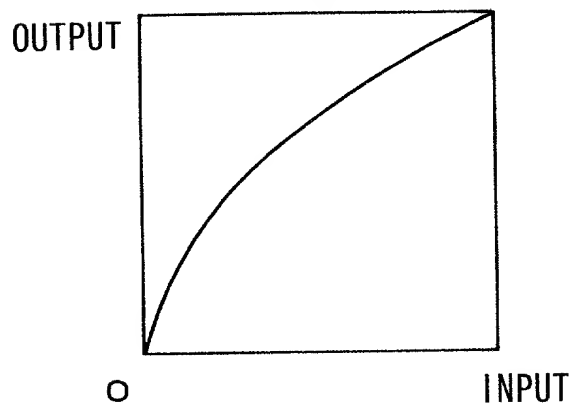


FIG. 6D

HIGHLIGHT-SHADOW PREFERENCE TYPE

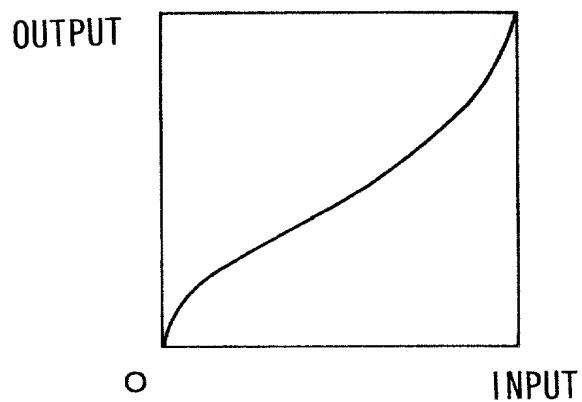


FIG. 7

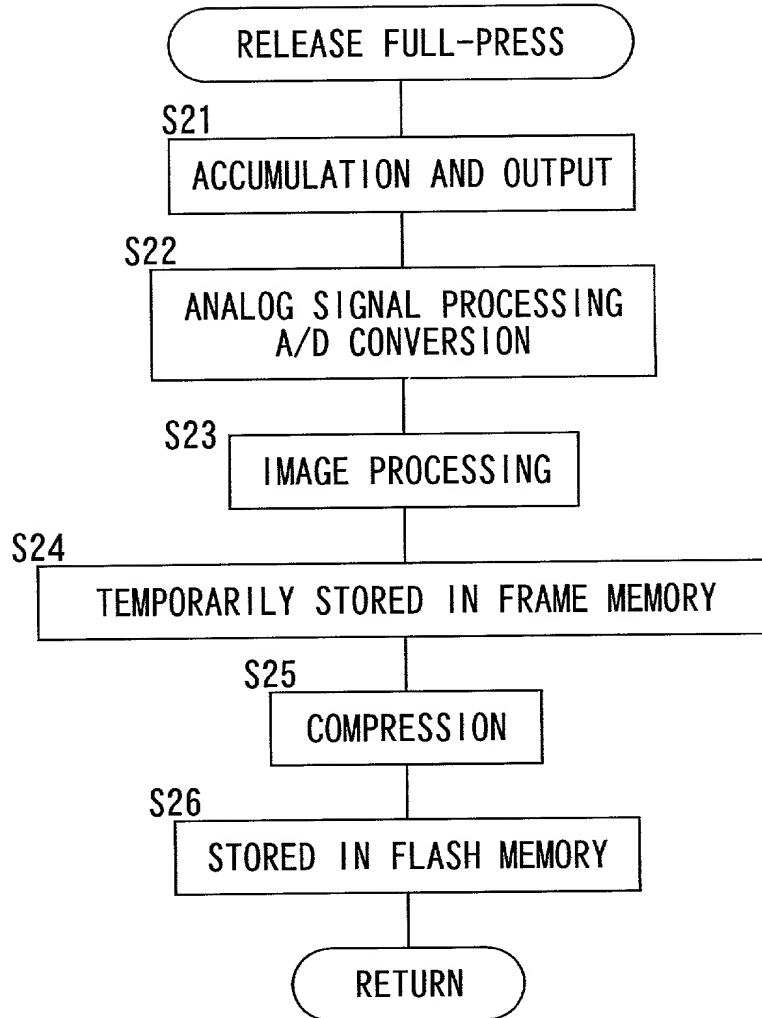
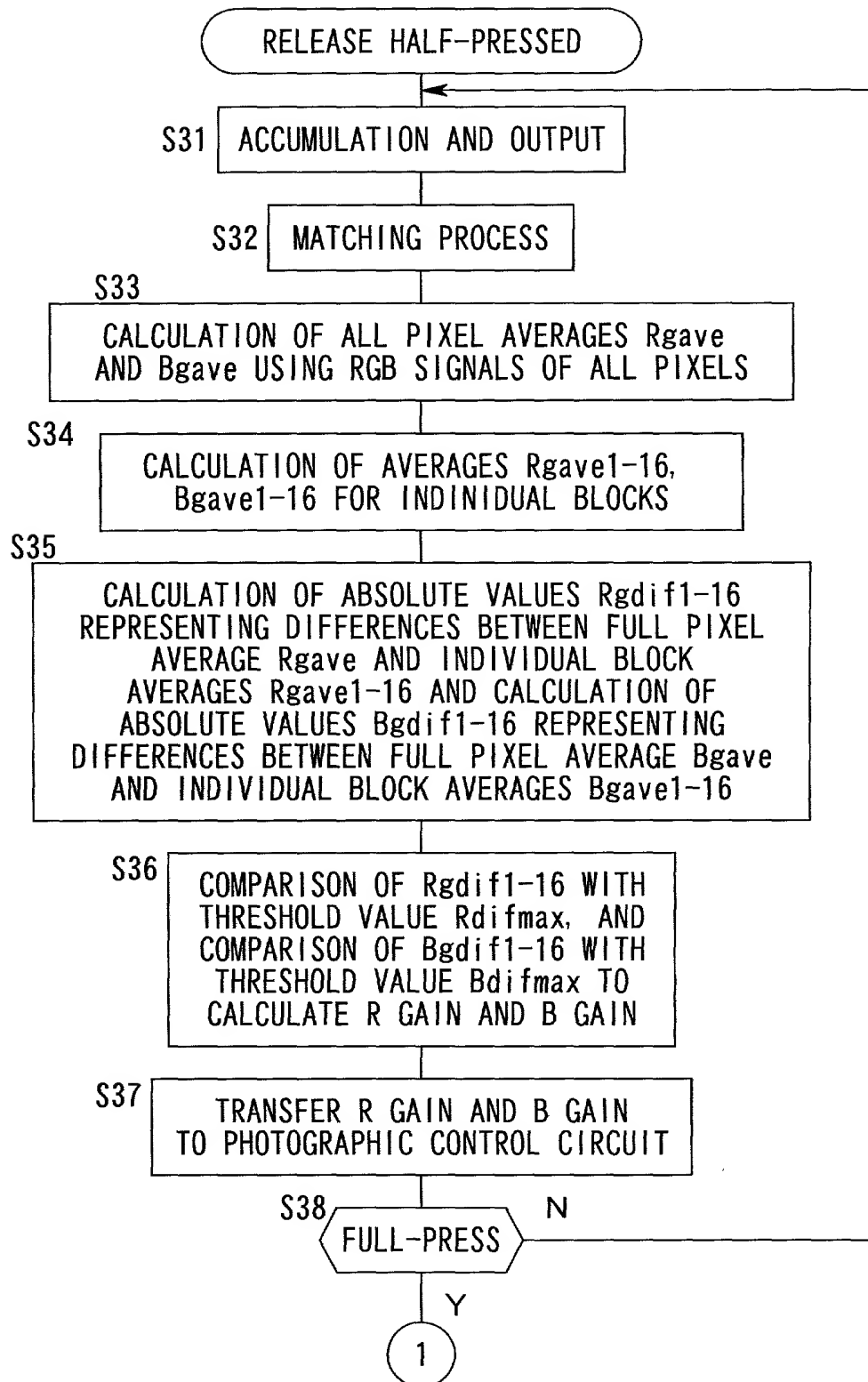
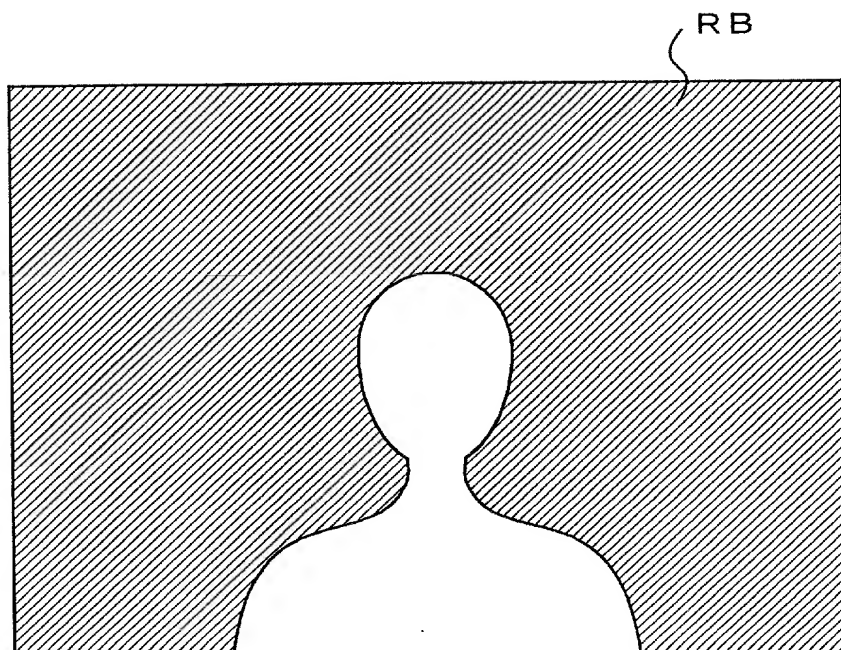


FIG. 8



665440-2200

FIG. 9



# APPLICATION FOR UNITED STATES PATENT DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: ELECTRONIC STILL CAMERA AND INFORMATION RECORDING

## APPARATUS

described and claimed in the specification:

### Check one

- \*a. ☒ attached hereto.  
b. ☐ filed on \_\_\_\_\_ as Application No. \_\_\_\_\_ and amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

Under Title 35, U.S. Code §119, the priority benefits of the following foreign application(s) and/or United States provisional application(s) filed within one year prior to this application are hereby claimed:

Japanese Patent Application No.10-106548 filed April 16,1998

The following application(s) for patent or inventor's certificate on this invention were filed in countries foreign to the United States of America either (a) more than one year prior to this application, or (b) before the filing date of the above-named foreign priority application(s) and/or United States provisional application(s):

I hereby appoint the following as my attorneys of record with full power of substitution and revocation to prosecute this application and to transact all business in the Patent Office:

James A. Oliff, Reg. No. 27,075; William P. Berridge, Reg. No. 30,024;  
Kirk M. Hudson, Reg. No. 27,562; Thomas J. Pardini, Reg. No. 30,411;  
Edward P. Walker, Reg. No. 31,450; Robert A. Miller, Registration No. 32,771 and  
Mario A. Costantino, Registration No. 33,565.

ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO OLIFF & BERRIDGE, P.L.C., P.L.C., P.O. BOX 19928, ALEXANDRIA, VIRGINIA 22320, TELEPHONE (703) 836-6400.

I hereby declare that I have reviewed and understand the contents of this Declaration, and that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1	<b>Typewritten Full Name of First or Sole Inventor</b>	<u>Michihiro</u>	<u>TAMUNE</u>
		Given Name	Middle Initial
2	**Inventor's Signature:	<u>Michihiro</u>	<u>Tamune</u>
3	**Date of Signature:	<u>4</u>	<u>10</u>
		Month	Day
	Residence:	<u>Yokohama-shi</u>	<u>KANAGAWA</u>
		City	State or Province
	Citizenship:	<u>Japan</u>	<u>JAPAN</u>
		Country	
	Post Office Address: (Insert complete mailing address, including country)	<u>C/O Nikon Corporation, Fuji Bldg., 2-3, Marunouchi 3-chome, Chiyoda-ku, TOKYO, 100-8331 JAPAN</u>	

\*If Box (a.) is checked, this form may be executed only when attached to the specification (including claims).

\*\*Note to Inventor: Please sign name exactly as it appears above and insert actual date of signing.

IF THERE IS MORE THAN ONE INVENTOR USE PAGE 2 AND PLACE AN "X" HERE ☐